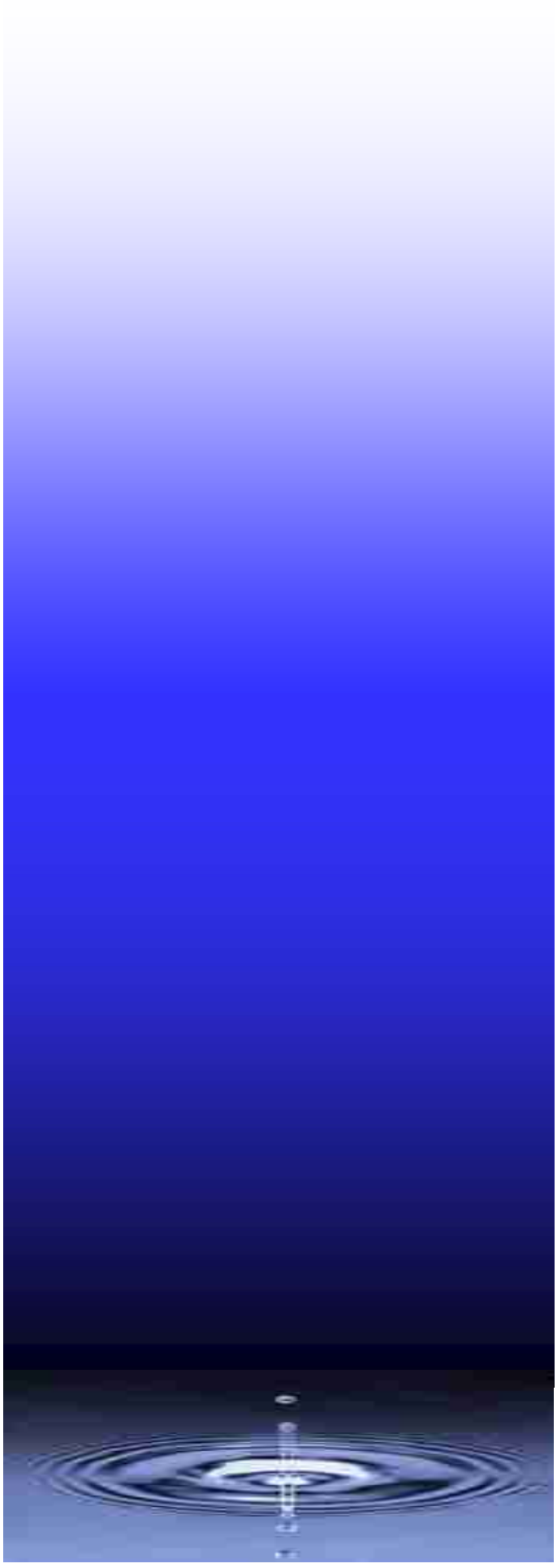

Report No 1613

PORT OF TYNE AUTHORITY

WORK PLAN FOR SEA DISPOSAL TRIALS OF CONTAMINATED TYNE ESTUARY SEDIMENT

August 2004

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1. INTRODUCTION

This work plan has been prepared for the Port of Tyne Authority (PTA), to provide details of sea disposal trials of contaminated dredge material (CDM) from the Tyne Estuary.

The PTA submitted an application for sea-disposal of dredged material to DEFRA on 20 February 2003. This work plan is for a trial revising the sea-disposal method of the original February 2003 application.

The proposal for sea-disposal trials developed from discussions between the Port of Tyne Authority, DEFRA, CEFAS and EnviroCentre as to the best practical environmental options for disposal of CDM arising from maintenance and clean up dredging in the Tyne Estuary. The development of the work plan has included liaison with CEFAS, DEFRA and the EA, the review of engineering techniques employed by the US Army Corp of Engineers and research undertaken by the PTA, EnviroCentre and PIANC.

It should be noted that a Memorandum of Understanding will be produced identifying the responsibilities of key organisations for work components detailed in this plan.

2. PURPOSE OF TRIAL

The overall purpose of the trial is to undertake and assess the sea-disposal and capping of CDM from the Tyne Estuary, in order to develop a best practice that is extendable to the UK.

The detailed aims of the trial are as follows:

- To accurately delineate areas, depths and volumes of CDM to be removed from three priority docks in the Tyne Estuary (Wallsend Dry Docks, Neptune Quay and Swan Hunters - Slipway Ends).
- To determine the physical and chemical characteristics of the CDM.
- To remove the CDM from priority docks utilising dredging techniques that retain the material in discrete solid blocks and ensure minimal loss of CDM during the dredging operation.
- To accurately place CDM blocks in a delineated area of the Souter Point (Outer) disposal grounds, ensuring there is no loss of CDM during transport and minimal contaminant loss to the water column during placement.
- To cover the CDM with a pre-designed cap, based on methods used by the US Army Corp of Engineers, ensuring there is minimal disturbance of CDM during the placement of cap material, and that there is adequate thickness of capping material over the whole volume of the deposited CDM.
- To assess the effectiveness of the sea-disposal and capping trial.
- To ensure the long-term maintenance integrity and efficacy of the cap through monitoring, with cap maintenance where required.
- To use findings of the trial to develop a best practice that is extendable to the UK.

3. DELINEATION OF AREAS FOR CONTAMINATED SEDIMENT DREDGING

3.1 Purpose

The purpose of this section is to identify and delineate the areas for contaminated sediment dredging. Three priority docks have been chosen within the Tyne Estuary for the sea-disposal trials, they are the Wallsend Dry Docks, Neptune Yard and Swan Hunters (Slipway Ends). The location of these docks is shown in Figure 1.

Dredging is required in these areas for maintenance of depth and for clean-up purposes. Details of the areas in which dredging is proposed are provided in the following sections.

3.2 Wallsend Dry Docks

The Wallsend Dry Docks are owned by A&P Tyne Ltd and include the following docks and quays:

1. A&P No1 dry dock
2. A&P No2 dry dock
3. A&P No3 dry dock
4. Dry docks and Engine Works Quay

3.2.1 Area of Dredging

The area of sediment removal from the Wallsend Dry Docks is shown in Figure 1 and Appendix I. A bathymetric survey showing the existing sediment surface (metres below chart datum) for the dock is provided in Appendix II

3.2.2 Dredging Depths

Dredging is required to remove sediment from the Wallsend Dry Docks, to lower the sediment surface to the depths (metres below chart datum) shown in Table 1 and in Appendix I.

3.2.3 Depths of Sediment Removal

The depth of sediment to be removed from the Wallsend Dry Docks is shown in Appendix III.

3.2.4 Volumes of Sediment to be Removed

The calculation of sediment volumes to be removed from the four docks/quays that comprise the Wallsend Dry Docks, involved the comparison between the digital terrain model for each area (created from bathymetric data) and level surfaces (defined by the design depths) bounded by clipping polygons. The actual polygons used in the calculations can be seen on the volume computation sheets presented in Appendix IV. For each dock/quay, computation sheets are produced for the design depth and for the

design depth plus over-dredge. It should be noted that in some cases the volumes shown may be slightly less than the volumes to be removed due to lack of data within the clipping polygons.

The volumes to be removed from the four docks/quays of the Wallsend Dry Docks are presented in Table 1 below. The total volume to be removed from the Wallsend Dry Docks is 17,455 cubic metres (20,959 cubic metres with over-dredge) (Table 1).

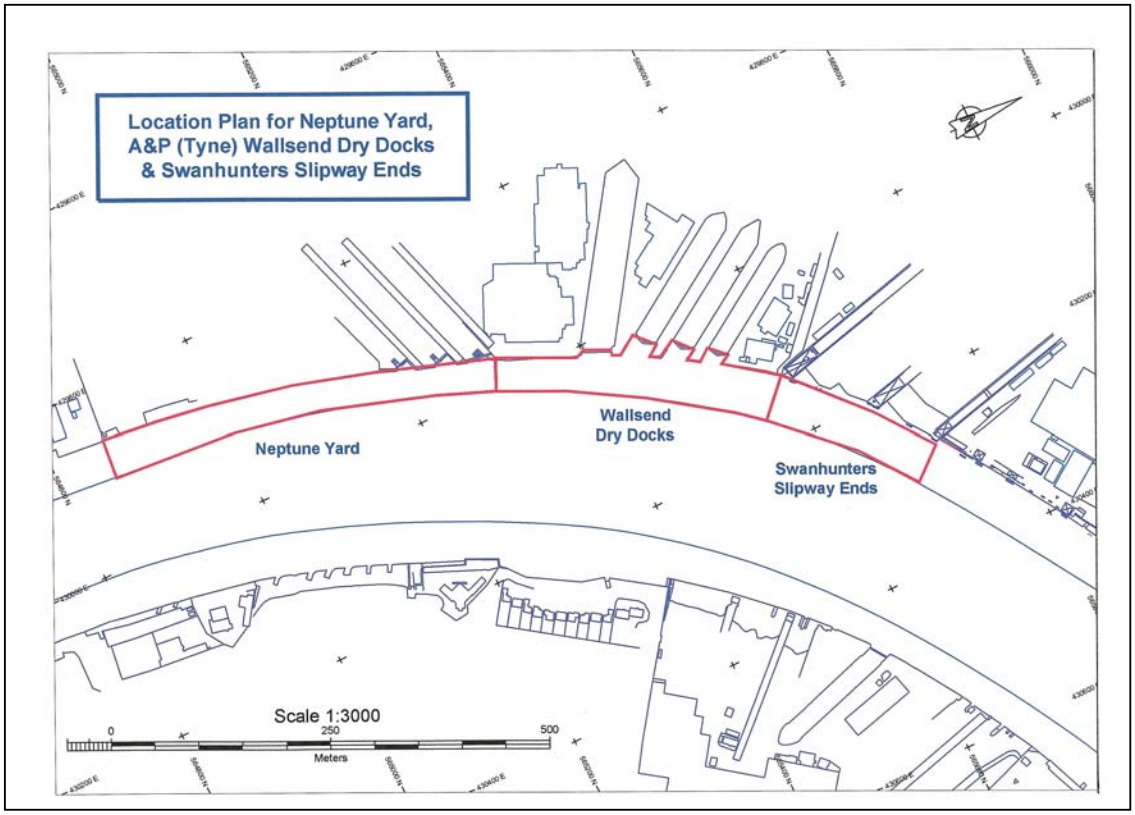


Figure 1. Area of sediment removal for the Neptune Yard, Wallsend Dry Docks and Swanhunters (Slipway Ends)

Table 1. Required sediment-surface depth (metres below chart datum) and volumes of sediment removal for the Wallsend Dry Docks.

Area within the Wallsend Dry Dock	**Required sediment-surface depth (metres below chart datum)**	**Volume of sediment removal (cubic metres)**	**Required sediment-surface depth including over-dredge (metres below chart datum)**	**Volume of sediment removal including over-dredge (cubic metres)**
A&P No1 dry dock	3.5	245	3.8	348
A&P No2 dry dock	3.5	129	3.8	191
A&P No3 dry dock	3.5	377	3.8	520
Dry docks and Engine Works Quay	7.7	16704	8.0	19900

3.3 Neptune Yard

The Neptune Yard is owned by Newcastle City Council. It is located adjacent to the Wallsend Dry Docks as shown in Figure 1.

3.3.1 Area of Dredging

The area of sediment removal from the Neptune Yard is defined in Figure 1 and Appendix I. A bathymetric survey showing the existing sediment surface (metres below chart datum) for the quay is provided in Appendix II.

3.3.2 Dredging Depths

Dredging is required to remove sediment from Neptune Yard, to lower the sediment surface to the depth (metres below chart datum) shown in Table 2 and in Appendix I.

3.3.3 Depths of Sediment Removal

The depth of sediment that will need to be removed from the Neptune Yard is shown in Appendix III.

3.3.4 Volumes of Sediment to be Removed

The calculation of sediment volumes to be removed from the Neptune Yard, involved the comparison between the digital terrain model for the area (created from bathymetric data) and level surfaces (defined by the design depths) bounded by clipping polygons. The actual polygons used in the calculations can be seen on the volume computation sheets presented in Appendix V. A computation sheet is produced for the design depth and for the design depth plus over-dredge. It should be noted that in some cases the volumes shown may be slightly less than the volumes to be removed due to lack of data within the clipping polygons.

The total volume to be removed from the Neptune Yard is 25,346 cubic metres (29,314 cubic metres with over-dredge) as shown in Table 2.

Table 2. Required sediment-surface depth (metres below chart datum) and volumes for sediment removal for Neptune Yard.

Quay/Dock	**Required sediment-surface depth (metres below chart datum)**	**Volume of sediment removal (cubic metres)**	**Required sediment-surface depth including over-dredge (metres below chart datum)**	**Volume of sediment removal including over-dredge (cubic metres)**
Neptune Yard	7.1	25,346	7.4	29,314

3.4 Swan Hunters – Slipway Ends

The Swan Hunters (Slipway Ends) is owned by Swan Hunters (Tyneside) Ltd. It is located adjacent to the Wallsend Dry Docks as shown in Figure 1.

3.4.1 Area of Dredging

The area of sediment removal from Swan Hunters (Slipway Ends), is defined in Figure 1. A bathymetric survey showing the existing sediment surface (metres below chart datum) for the quay is provided in Appendix VI.

3.4.2 Dredging Depths

Dredging is required to remove sediment from Swan Hunters (Slipway Ends), to lower the sediment surface to the depth (metres below chart datum) shown in Table 3.

3.4.3 Depths of Sediment Removal

The depth of sediment that will need to be removed from the quay is shown in Appendix VII.

3.4.4 Volumes of Sediment to be Removed

The calculation of sediment volumes to be removed from Swan Hunters (Slipway Ends), involved the comparison between the digital terrain model for the area (created from bathymetric data) and level surfaces (defined by the design depths) bounded by clipping polygons. The actual polygons used in the calculations can be seen on the volume computation sheets presented in Appendix VIII. A computation sheet is produced for the design depth and for the design depth plus over-dredge. It should be noted that in some cases the volumes shown may be slightly less than the volumes to be removed due to lack of data within the clipping polygons.

The total volume to be removed from Swan Hunters (Slipway Ends) is 6,152 cubic metres (8,534 cubic metres with over-dredge) as shown in Table 3.

Table 3. Required sediment-surface depth (metres below chart datum) and volumes for sediment removal for Swan Hunters (Slipway Ends).

Quay/Dock	**Required sediment-surface depth (metres below chart datum)**	**Volume of sediment removal (cubic metres)**	**Required sediment-surface depth including over-dredge (metres below chart datum)**	**Volume of sediment removal including over-dredge (cubic metres)**
Swan Hunters (Slipway Ends)	7.5	6,152	7.8	8,534

3.5 Total Volume of Sediment for Sea Disposal Trials

The total volume of sediment to be removed from the three priority docks for the sea disposal trials is 48,953 cubic metres (58,807 cubic metres with over-dredge) as shown in Table 4 below.

Table 4. Total volume of sediment to be removed from docks for sea-disposal trials.

Quay/Dock	**Volume of sediment removal (cubic metres)**	**Volume of sediment removal including over-dredge (cubic metres)**
Wallsend Dry Docks (including Engine Works Quay)	17,455	20,959
Neptune Yard	25,346	29,314
Swan Hunters (Slipway Ends)	6,152	8,534
TOTAL VOLUME	**48,953**	**58,807**

4. CHARACTERISATION OF CONTAMINATED SEDIMENT

4.1 Purpose

Characterisation of CDM from the priority docks is required prior to the sea-disposal trials in order to understand the nature of the sediment in terms of its chemical and physical properties, to allow a prediction of both short and long term behaviour of the sediments and to provide benchmarking for post disposal monitoring.

4.2 Method

Samples of sediment will be collected from the three priority docks, Wallsend Dry Docks, Neptune Yard and Swan Hunters (Slipway Ends). The distribution and depth of sampling will reflect the size and depth of the area to be dredged, the amount to be dredged and the expected variability in the horizontal and vertical distribution of contaminants as per the requirements of OSPAR (1998).

The data collected will then be assessed along with data collected by the PTA in June 2003. The Posford Duvivier (1999) *River Tyne Contamination Study*, will also be referred to during the assessment.

4.2.1 Sampling Locations

The proposed method for sample collection at the three priority docks is based on monitoring plans and sampling blocks used by Posford Duvivier in 1999. The method also takes into account the monitoring undertaken by the PTA in June 2003 and recommendations by CEFAS.

Sampling requirements for the proposed monitoring are presented in Table 5. The sample location points are presented in Figures 2, 3 and 4 along with the June 2003 and 1999 monitoring points.

It should be noted that a plan of the original sampling blocks used by Posford Duvivier to monitor Engine House Quay (Wallsend Dry Docks) in 1999 is not available. Therefore, a new sampling block has been produced for this area and two sample locations chosen at random within the block.

Table 5. Sampling required at Wallsend Dry Dock, Neptune Quay and Swan Hunters (Slipway Ends) for the sea-disposal trials.

Dock/Quay	**Surface Grab Samples***	**Core Samples***
Wallsend Dry Dock, Engine House Quay	12/E2 and 12/E7	
Wallsend Dry Dock	12/23	Core to 2m at 12/6, 12/11
Neptune Quay	12/14, 12/16, 12/18	Core to 3.5m at 12/25, 12/11
Swan Hunters (Slipway Ends)	22/20	Core to 2m at 21/8

* The location numbering system refers firstly to the plan number presented by Posford Duvivier (1999) and secondly to the numbered sampling blocks within the plan.

Figure 2. Location of sampling points for monitoring undertaken in 1999, June 2003 and proposed additional monitoring at the Wallsend Dry Dock and Neptune Quay.

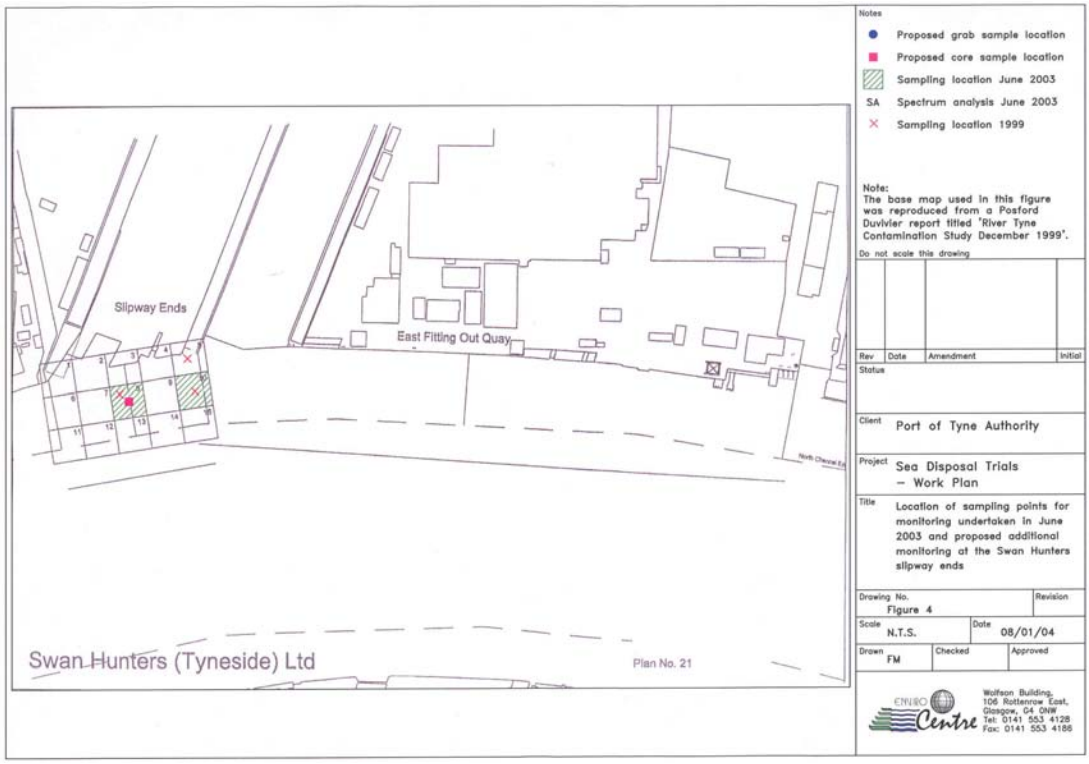


Figure 3. Location of sampling points for monitoring undertaken in 1999, June 2003 and proposed additional monitoring at Swan Hunters (Slipway Ends) - I.

Figure 4. Location of sampling points for monitoring undertaken in 1999, June 2003 and proposed additional monitoring at Swan Hunters (Slipway Ends) - II.

4.2.2 Sampling Method

The proposed sampling method is as follows:

1. All samples will be taken from the centre of the grid boxes shown in Figure 2, Figure 3 and Figure 4.

2. Surface samples will be collected by boat using a stainless steel Van Veen Grab. Non-metallic scoops will be used to remove sediment from the grab and for placement into suitable containers (plastic sample bags, glass jars (aluminium seal & plastic lid) or plastic containers).

3. Depth samples will be taken using a vibro-corer. Samples will be taken from the sediment core using non-metallic scoops at the surface and then at 1m intervals. The core will then be retained in its intact state for geo-technical analysis.

4. The grab sampler, vibro-cores, utensils and boat deck are to be washed down after a sample is taken to avoid cross-contamination.

5. There will be no eating or smoking during the sampling operations.

6. Sediment samples for chemical analysis will be split on collection. One set will be forwarded to CEFAS and the other to Mountain Heath Laboratories.

7. Samples will be refrigerated and kept close to freezing prior to and during transportation to the laboratories.

4.2.3 Field Records

The latitude and longitude or NGR for each sample location will be recorded. A map showing the sampling locations will also be prepared.

4.2.4 Physical Parameters

The physical characteristics of the CDM are important in predicting the behaviour of the material during and following placement at the site chosen for the sea-disposal trials (USACE, 1998). Data is required to evaluate dispersion (water column effects) and spread during placement, mounding characteristics, long-term stability and resistance to erosion (USACE, 1998).

The requirements for assessment of the physical properties of sediment from the three priority docks are presented in Table 6.

Table 6. Physical characterisation requirements for CDM.

Determinant	**Indicating**
Grain size (% sand, silt, clay) Percent solids (dry matter)	Cohesiveness, settling, velocity/re-suspension potential and contaminant accumulation potential
Bulk density Specific gravity	To indicate the potential behaviour of material during and after deposition. Required to design cap and interpret monitoring data
Consolidation test / shear test / plasticity indices	To indicate the potential behaviour of material during and after deposition
Total Organic Carbon	Provides an indication of how material will behave in the water column as it descends to the seabed.
Permeability Test	Indicates the rate of movement of water through material.

Percent solids is a standard test and should be undertaken on all sediment samples. Full physical characterisation as shown in Table 6, should be undertaken for a composite sample collected from the surface and at 1m intervals for each core sample.

4.2.5 Chemical Parameters & Elutriate Testing

Chemical analysis will be the same as the June 2003 monitoring event and will include the analyses listed in Table 7. This suite of analyses will be undertaken on all grab samples collected from the three priority docks and for samples taken from surface and at 1m intervals for each core. This will allow an assessment of stratification.

Elutriate testing of the CDM can allow the assessment of potential water-column contaminant release during the placement of sediment to the seabed. It is recommended that this test be undertaken on one grab sample from each of the priority docks.

Table 7. Chemical characterisation requirements for CDM

Determinant Group	**Determinant**
Organo-tins	DBT, TBT
Metals	As, Cd, Cr, Cu, Hg, Ni, Pb, Zn
Organics	Total PCBs, PAHs (23 substances), Total hydrocarbon content
Elutriate Test	TBT, trace metals and total hydrocarbons.

4.2.6 Sampling and Analytical Schedule for Wallsend Dry Docks

The sampling and analytical schedule for Wallsend Dry Docks is presented in Table 8.

Table 8. The sampling and analytical schedule for Wallsend Dry Docks.

Dock/Quay	**Sample Locations**	**Physical Parameters**	**Chemical Parameters**
Wallsend Dry Docks (Engine House Quay)	12/E2 Surface	Percent solids	DBT, TBT As, Cd, Cr, Cu, Hg, Ni, Pb, Zn Total PCBs, PAHs (23 substances), total hydrocarbon content
	12/E7 Surface	As above	As above
Wallsend Dry Docks	12/23 Surface	As above	DBT, TBT As, Cd, Cr, Cu, Hg, Ni, Pb, Zn Total PCBs, PAHs (23 substances), total hydrocarbon content
	12/6 Core (2m)	One composite combining sub-samples from surface, 1m and 2m of core. Grain size, percent solids, bulk density, specific gravity, consolidation test, total organic carbon, permeability test, shear test & plasticity indices	Individual samples from surface, 1m and 2m of core Parameters as above
	12/11 Core (2m)	One composite combining samples from surface, 1m and 2m of core. Parameters as above	Individual samples from surface, 1m and 2m of core Parameters as above Elutriate Test (additional grab)

4.2.7 Sampling and Analytical Schedule for Neptune Yard

The sampling and analytical schedule for Neptune Yard is presented in Table 9.

Table 9. The sampling and analytical schedule for Neptune Yard.

Dock/Quay	**Sample Locations**	**Physical Parameters**	**Chemical Parameters**
Neptune Yard	12/14 Surface	Percent solids	DBT, TBT As, Cd, Cr, Cu, Hg, Ni, Pb, Zn Total PCBs, PAHs (23 substances), total hydrocarbon content
	12/16 Surface	As above	As above
	12/18 Surface	As above	DBT, TBT As, Cd, Cr, Cu, Hg, Ni, Pb, Zn Total PCBs, PAHs (23 substances), total hydrocarbon content
	12/25 Core (3.5m)	One composite combining samples from surface, 1m, 2m & 3m of core. Grain size, percent solids, bulk density, specific gravity, consolidation test, total organic carbon, permeability test, shear test & plasticity indices	Individual samples from surface, 1m, 2m & 3m of core Parameters as above
	12/11 Core (3.5m)	One composite combining samples from surface, 1m, 2m & 3m of core. Parameters as above	Individual samples from surface, 1m, 2m & 3m of core Parameters as above Elutriate Test (additional grab)

4.2.8 Sampling and Analytical Schedule for Swan Hunters (Slipway Ends)

The sampling and analytical schedule for Swan Hunters (Slipway Ends) is presented in Table 10.

Table 10. The sampling and analytical schedule for Swan Hunters (Slipway Ends).

Dock/Quay	Sample Locations	Physical Parameters	Chemical Parameters
Swan Hunters (Slipway Ends)	22/20 Surface	Percent solids	DBT, TBT As, Cd, Cr, Cu, Hg, Ni, Pb, Zn Total PCBs, PAHs (23 substances), total hydrocarbon content
	21/8 Core (2m)	One composite combining samples from surface, 1m & 2m of core. Grain size, percent solids, bulk density, specific gravity, consolidation test, total organic carbon, permeability test, shear test & plasticity indices	Individual samples from surface, 1m and 2m of core Parameters as above Elutriate Test (additional grab)

4.3 Management Responsibilities

The PTA will be responsible for the management of the sampling program, for ensuring that sampling and analysis is of good quality, and for the sub-contracting of work where required, for example the collection of vibro-cores. The organisation undertaking the vibro-coring will be responsible for sample collection, sub-sampling of cores, organising geo-technical analysis at an accredited laboratory, the preserving and forwarding of samples to laboratories and for establishing a chain of custody.

EnviroCentre under contract to PTA, and CEFAS will be responsible for assessing the results of the monitoring program. This will be documented in a Memorandum of Understanding detailing the responsibilities of key organisations for different work components.

4.4 Health & Safety

The PTA will be responsible for ensuring that staff are fully aware of health and safety requirements, that a H&S risk assessment is undertaken prior to sampling and that all staff have adequate personal protective equipment. All contractors will be required to provide H&S documentation and will be responsible for ensuring that their staff have adequate personal protective equipment and are aware of H&S requirements.

4.5 Quality Control

The sampling methods documented in this work plan will ensure that there is minimal cross contamination between samples. It will also ensure that samples are collected in appropriate containers, are clearly identified and adequately preserved.

Chain of custody formwork will be utilised to ensure that each sample has a unique identification number. Samples can then be tracked through the delivery and analytical process and data can be linked directly to a particular sample location.

CEFAS and Mountain Heath laboratories will undertake chemical analysis and testing for percentage total solids. Both laboratories are UKAS accredited. Geo-technical tests will be undertaken by a UKAS accredited laboratory identified by the company contracted to undertaken vibro-coring.

4.6 Timeframes

The collection of samples from the three priority docks will require approximately 5 days. Analytical results should be available within three to four weeks of sample submission.

5. CHARACTERISATION OF CAPPING SEDIMENTS

5.1 Purpose

The purpose of this work component is to undertake characterisation of capping sediments to demonstrate that the material is acceptable for open water placement and to allow for the design of the cap.

5.2 Method

5.2.1 Sampling Locations & Analytical Parameters

Clean sediment will be dredged from the centre of the Tyne Estuary channel and will be used as the first capping layer. It is considered that the silt and clay content of this material will limit the movement of water through the cap and significantly reduce chemical flux (advection and diffusion) of contaminants. Clean sand from the harbour will be utilised as the second capping layer to reduce the impacts of erosion and bio-turbation and hold the contaminated material and first capping layer in place.

It is estimated that 90,000 cubic metres of cap material (sand and silty sediment) will be required.

Sediment in the central channel of the Tyne Estuary and at the harbour mouth is known to be clean therefore, it is considered that two surface samples collected from representative locations in each area will be sufficient to characterise the capping material. The proposed location for sampling is shown in Figure 5.

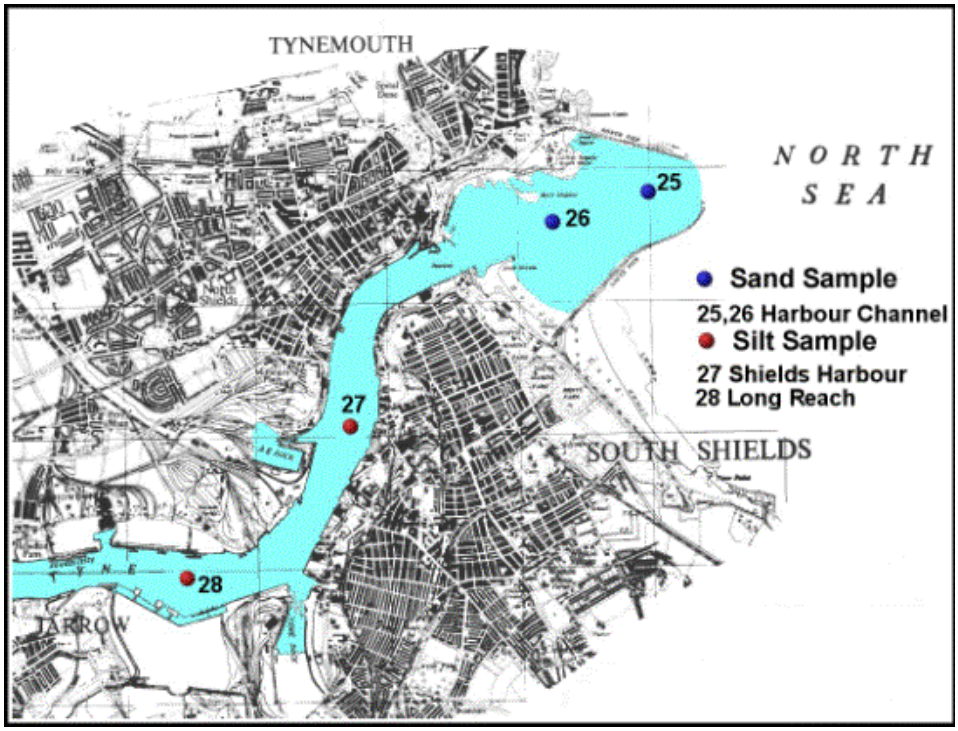


Figure 5. Sampling location points for the characterisation of capping material.

5.2.2 Sampling Method

The sampling methods utilised will be as per Section 4.2.2. The sediment and sand samples will be split. One set will be sent to CEFAS and the other to Mountain Heath Laboratories. The analytical schedule is provided in Table 11.

Table 11. Sampling schedule for cap material

Sample Locations	**Samples**	**Physical Parameters**	**Chemical Parameters**
Tyne Estuary Centre of Channel	Two surface samples	Grain size, percent solids, bulk density, specific gravity, consolidation test, total organic carbon, permeability test, shear test & plasticity indices	DBT, TBT As, Cd, Cr, Cu, Hg, Ni, Pb, Zn Total PCBs, PAHs (23 substances), total hydrocarbon content
Harbour Mouth	Two surface samples	As above	As above

5.3 Management Responsibilities

The PTA will be responsible for the management of the cap material sampling program, for ensuring that sampling and laboratory analysis is of good quality, and for the sub-contracting of work where required.

EnviroCentre under contract to PTA, and CEFAS will be responsible for assessing the results of the monitoring program. This will be documented in a Memorandum of Understanding detailing the responsibilities of key organisations for different work components.

5.4 Health & Safety

The PTA will be responsible for ensuring that staff are fully aware of health and safety requirements, that a H&S risk assessment is undertaken prior to sampling and that all staff have adequate personal protective equipment. All contractors will be required to provide H&S documentation and will be responsible for ensuring that their staff have adequate personal protective equipment and are aware of H&S requirements.

5.5 Quality Control

The sampling methods documented in this work plan, will ensure that there is minimal cross contamination between samples. It will also ensure that samples are collected in appropriate containers, are clearly identified and are adequately preserved.

Chain of custody formwork will be utilised to ensure that each sample has a unique identification number. Samples can then be tracked through the delivery and analytical process and data can be linked directly to a particular sample location.

CEFAS and Mountain Heath laboratories will undertake chemical analysis and testing for percentage total solids. Both laboratories are UKAS accredited. Geo-technical tests will be undertaken by a UKAS accredited laboratory identified by the consultants undertaking vibro-coring of the priority docks/quays.

5.6 Timeframes

The collection of samples from the areas proposed for cap material dredging will require approximately 2 days. Analytical results should be available within three to four weeks of sample submission.

6. CDM DREDGING

6.1 Purpose

The purpose of this work component is to accurately dredge delineated areas and depths of contaminated sediment from three priority docks, Wallsend Dry Docks, Neptune Quay and Swan Hunters (Slipway Ends), utilising mechanical dredging techniques that ensure CDM is retained in blocks, that there is minimal loss of contaminated material during dredging and no loss of during transport.

6.2 Method

Mechanical dredging will be used to remove CDM from the delineated areas within the three priority docks. This technique is ideal for creating sub-aqueous mounds as CDM is retained in discrete solid blocks and stays close to in-situ density throughout the dredging process (USACE, 1998). As a result, less water is entrained during dredging and there is minimal stripping of material during descent to the seabed. In addition, the material spread on the bottom is reduced and material will tend to mound rather than flow particularly if combined with point dumping from a barge (USACE, 1998). Mechanical dredging also allows immediate placement of a cap, where as hydraulically dredged material requires time to allow for settlement.

The use of an enclosed bucket will also ensure there is minimal loss of contaminated material.

A summary of the dredging technique is provided below. More details can be found in Appendix IX.

- The sediments from the priority docks/quays will be physically lifted from the bottom utilising a backhoe aqua-digger with an enclosed bucket mounted on a spud pontoon. The bucket will be operated hydraulically via the arm of the excavator. The backhoe aqua digger will be manned for 24 working hours.

- Dredging will be performed in lanes of approximately 20m width. Over-dredge will be limited as far as practical to 300mm.

- The blocks of CDM will be placed rather than dropped, onto self-propelled split hopper barges moored alongside. This will retain the discrete and consolidated nature of the CDM blocks. The barges will be filled to a level that ensures that there is no overspill of entrained water and will be supplied with new seals to ensure that as far as possible there is no leakage during transport to the Souter Point (Outer) disposal grounds (Appendix IX).

- Back-up equipment will be available to ensure there are no delays due to equipment breakdown.

6.3 Equipment & Materials

Equipment and materials required include the following:

- One backhoe aqua-digger with an enclosed bucket mounted on a spud pontoon

- Back-up aqua-digger bucket.
- Two 800 cubic metre self-propelled split hopper barges
- One 1400 cubic metre self-propelled split hopper barge

6.4 Management Responsibilities

The PTA will be responsible for identifying a suitable contractor for the dredging, transport and disposal operations. The contractor will be responsible for undertaking dredging, transport and disposal operations to the specifications given in their method statement, for providing a contingency plan and back-up in case of bad weather or equipment failure and for ensuring that environmental, health and safety requirements are met.

PTA, EnviroCentre, EA, DEFRA and CEFAS may be present, as required, during the dredging and disposal operations.

A Memorandum of Understanding will be produced detailing the responsibilities of key organisations for different work components.

6.5 Environmental Issues

The key environmental issues associated with the dredging operations are:

- Sediment disturbance and associated migration of contaminants.
- The ingress of contaminated sediments out-with the delineated areas into the dredged dock.
- Breakdown of dredging equipment or bad weather could potentially delay operations increasing the time of exposure of CDM deposited at the trial site to the environment.
- Leakage and overspill of contaminated material from barges during transport.

The dredging technique employed (enclosed bucket) will ensure minimal CDM disturbance and loss. The ingress of contaminated sediments will be minimised by the removal of both contaminated and non-contaminated sediment from the three priority docks.

Contingency plans are in place and back-up equipment will provided to ensure that the risk of delay from the breakdown of equipment is low. The barges are designed to prevent overspill and they will be filled to a level that ensures that there is no overspill of entrained water or CDM. The barges will be supplied with new seals to ensure that as far as possible there is no leakage during transport to the Souter Point (Outer) disposal grounds

6.6 Health & Safety

The dredging contractor will be required to provide health & safety documentation covering dredging and disposal operations.

6.7 Quality Control

The dredging contractor will be required to demonstrate that dredging depths have been met and that sediment is retained in discrete blocks during operations.

6.8 Timeframes

The mobilisation, dredging, placement and demobilising operations for both the CDM and cap material will be approximately 47 days.

7. CAPPING MATERIAL DREDGING

7.1 Purpose

The purpose of this work component is to dredge capping material using hydraulic dredging techniques, ensuring there is minimal loss of sediment to the water column during the dredging operation.

7.2 Method

Clean capping material will be dredged from the centre of the channel in the Tyne Estuary and at the harbour mouth using standard trailer suction dredgers with subsequent disposal/placing on the disposal ground utilising the dredgers integral fall pipe (placed to a depth of 25m). Details of the method that will be employed are provided in Appendix IX.

7.3 Equipment & Materials

Equipment and materials required include the following:

- One trailer suction hopper dredger (2100 cubic metres) with two suction pipes.

7.4 Management Responsibilities

The PTA will be responsible for identifying a suitable contractor for the dredging, transport and disposal operations. The contractor will be responsible for undertaking dredging, transport and disposal operations to the specifications given in their method statement, for providing a contingency plan and back-up in case of equipment failure or bad weather, and for ensuring that environmental, health and safety requirements are met.

PTA, EnviroCentre, EA, DEFRA and CEFAS may be present, as required, during the dredging and disposal operations.

A Memorandum of Understanding will be produced detailing the responsibilities of key organisations for different work components.

7.5 Environmental Issues

The key environmental issues associated with the dredging operations are sediment disturbance and migration, which have the potential to settle and smother benthic organisms. The dredging technique employed will ensure minimal sediment disturbance.

Breakdown of dredging equipment or bad weather could potentially delay operations increasing the time of exposure of CDM deposited at the trial site to the environment. Contingency plans are in place and back-up equipment will be provided to ensure that the risk of delay from equipment breakdown is low.

7.6 Health & Safety

The dredging contractor will be required to provide health & safety documentation covering dredging and disposal operations.

7.7 Quality Control

The dredging contractor will be responsible for ensuring that material is dredged from the specified areas to the specifications provided in this document and the contractor method statement.

7.8 Timeframes

The mobilisation, dredging, placement and demobilising operations for both the CDM and cap material will be approximately 47 days.

8. SITE SELECTION FOR SEA DISPOSAL TRIALS

8.1 Purpose

The purpose of this section is to demonstrate the method used to select a suitable location for the placement and capping of CDM from the three priority docks.

8.2 Method

Two licensed disposal grounds are located near to the Tyne Estuary (North Tyne and Souter Point (Outer)) as shown in Figure 6. North Tyne disposal ground is on average shallower than Souter Point (Outer). Therefore, it is not considered as suitable for the trials due to the increased potential for disturbance by wave action.

The CDM from the three priority docks will therefore be placed in the Souter Point (Outer) disposal ground (Figure 6). This site is fully licensed for sea disposal and has already been characterised as a non-dispersive site. The depth of this site (40 to 50m) also ensures that the CDM will be placed in a low-energy environment where there is little potential erosion of the cap. The size of the disposal grounds is 749 hectares allowing sufficient area for the trials.

CEFAS monitor the Souter Point (Outer) disposal ground on an annual basis. The findings of sediment quality monitoring for TBT in 2002 and 2003 have been summarised in Figure 7 and Table 12.

CEFAS have also undertaken a multi-beam survey of the central and western area of the Souter Point (Outer) disposal ground as shown in Figure 8. The results of the sediment quality and bathymetric surveys have been utilised to identify suitable locations for the trials.

In assessing the sediment quality data and the multi-beam survey, the following points have been considered:

- The disposal ground has significant areas of previously disposed sediment. These areas can be delineated by bathymetric surveys and sediment quality data.
- The selected area for the trials should not be influenced by previously disposed sediment.
- The prevailing currents drift slowly to the south.
- The depth of the disposal ground falls from approximately 40 to 50 metres in an easterly direction.
- Natural depressions help protect against the prevailing currents and confine material. Placement in a natural depression also reduces the amount of capping material required.

Table 12. A summary of TBT data collected within and around the Souter Point (Outer) disposal ground by CEFAS in 2002 and 2003. Station locations and data are presented schematically in Figure 7.

Station Number	Year of Monitoring	TBT (ppm)	DBT (ppm)
36	2003	0.122	0.016
40	2003	0.038	0.005
40	2003	0.04	0.007
40	2003	0.051	0.009
40	2003	0.032	0.006
40B	2003	0.059	0.007
40B	2003	0.087	0.013
40B	2003	0.298	0.011
40B	2003	0.15	0.014
40B	2003	0.036	0.006
41	2003	0.21	0.025
77	2002	0.145	0.019
78	2002	0.063	0.015
79	2002	0.013	0.006
106	2003	0	0
108	2003	0	0
109	2003	0.008	0
113	2003	0.012	0.005
114	2003	0.005	0

8.3 Site Location For Disposal Trials

An assessment of sediment quality data and the multi-beam survey indicates that previous disposal operations have been concentrated in the north-west section of the disposal ground as shown by the shallower depths in this area (Figure 8) and elevated levels of TBT (Table 12 and Figure 7). This area is therefore not suitable for the sea-disposal trials. The area to the south of the location of previous disposal operations is also considered unsuitable, as there is potential for existing contaminated material to be dispersed over the trial area.

It is therefore considered that the trial should be located in the centre of the disposal ground for the following reasons:

1. Sediment quality data indicates that there has been minimal dispersion of TBT east of historical disposal operations.
2. Any dispersion of sediment from the trial area will be retained within the licensed area.
3. The proposed area falls in a natural basin, helping to confine disposed sediment.

The proposed zone for the sea disposal trials is illustrated in Figure 8. The coordinates delineating the proposed area are shown in Figure 9.

Contours for the proposed area for the trials are presented in Figure 10. This diagram shows that the trial area sits at a depth of 48m to 49m and that the sea-bed slopes away by 1m over the trial area in a north easterly direction. Figure 10 also shows that the waters are shallower to the south of the trial area, this should assist in retaining sediment in the trial area.

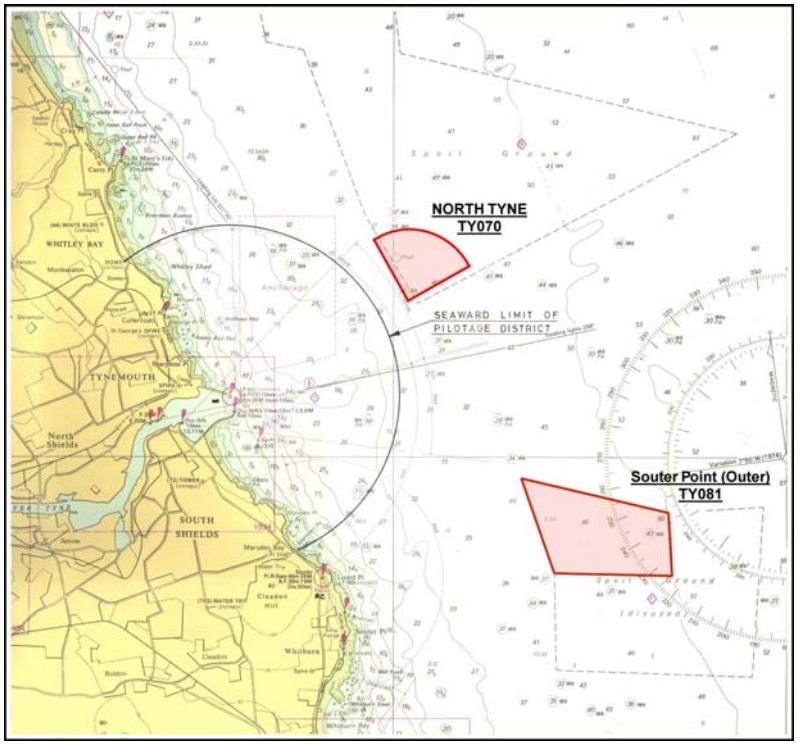


Figure 6. The location of the North Tyne and Souter Point (Outer) disposal grounds.

Figure 7. TBT levels in and around the Souter Point (Outer) disposal ground.

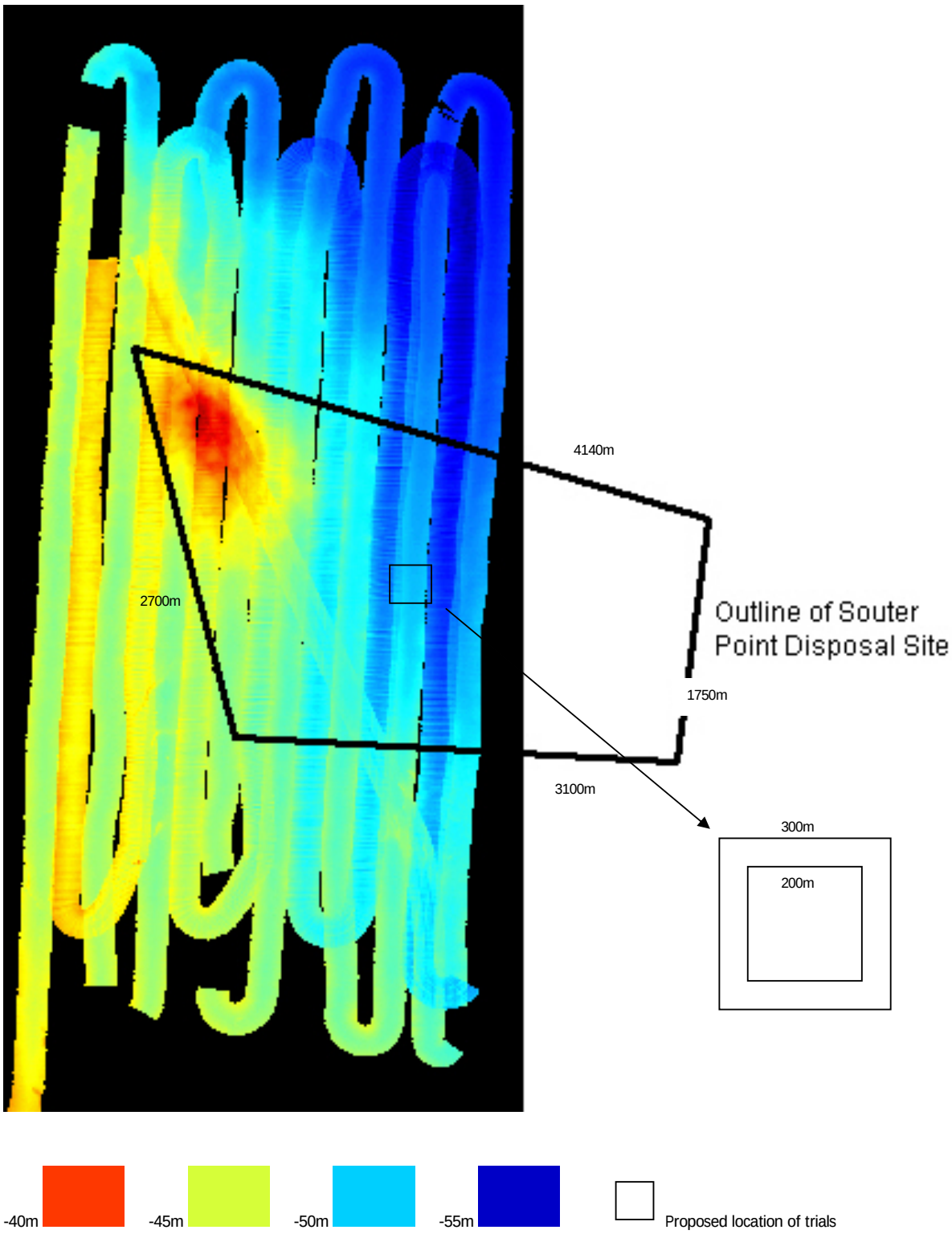
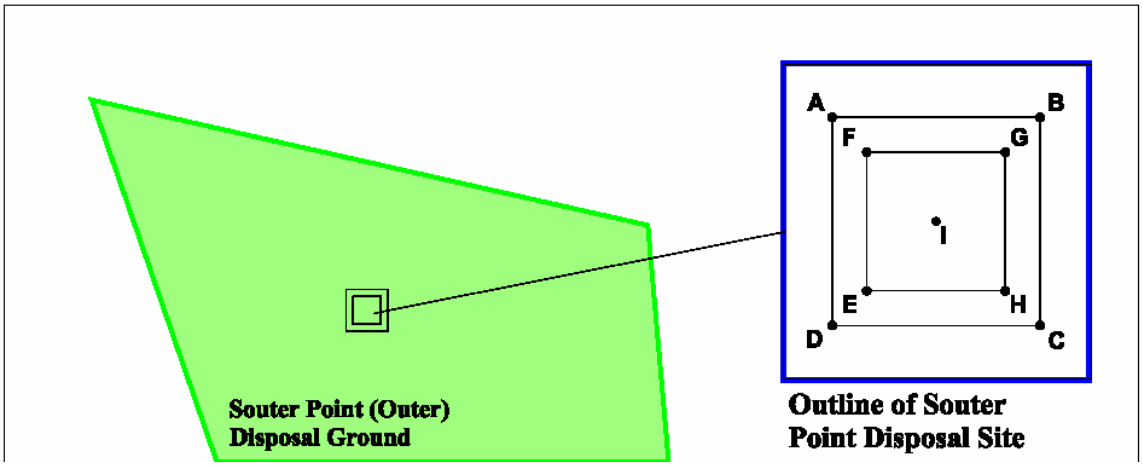


Figure 8. Results of the multi beam survey and proposed location of trials.



	Eastings (m)	Northings (m)
A	447950	565650
B	448250	565650
C	448250	565350
D	447950	565350
E	448000	565400
F	448000	565600
G	448200	565600
H	448200	565400
I	448100	565500

Figure 9. The co-ordinates (national grid) for the proposed trial location (not to scale).

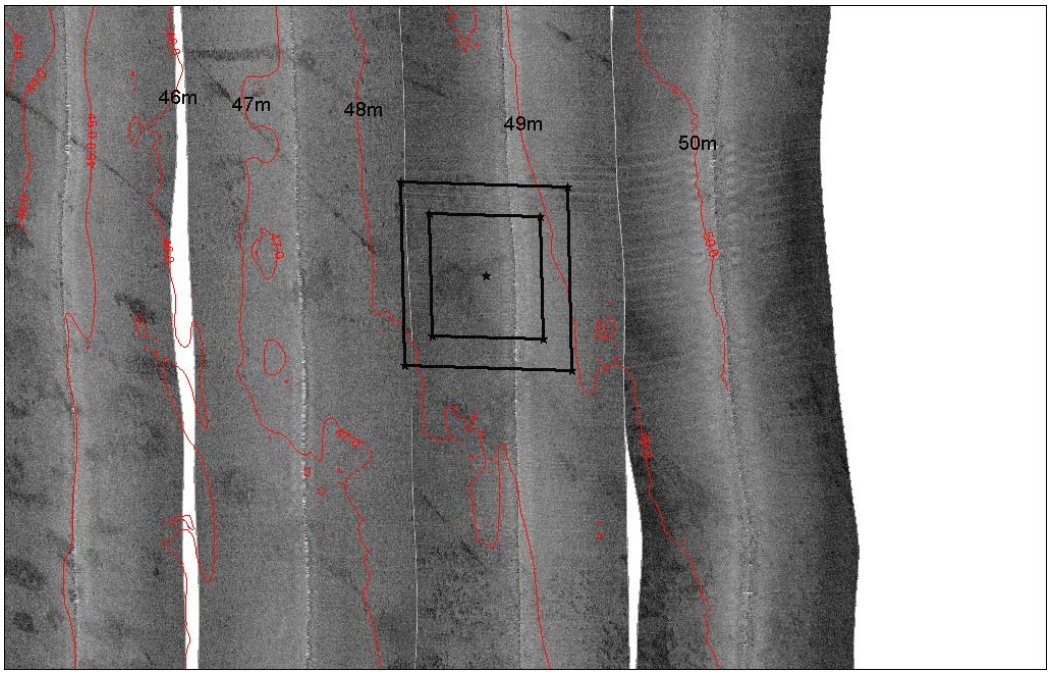


Figure 10. Depth contours for the proposed trial location.

9. CAP DESIGN

9.1 Purpose

The purpose of this section is to demonstrate the method used to design the cap for the sea-disposal trials, ensuring the placement of an adequate thickness of capping material over the whole volume of CDM, isolating the CDM from the environment and protecting against erosion.

9.2 Method

The method used for to design the cap is described below:

1. Dredging advisors consider that in the worse case scenario, 60,000 cubic metres of CDM deposited at one central point will settle to a thickness of 1.5m, giving a footprint of 4 hectares as shown schematically in Figure 11 below. The co-ordinates for the central point and the 4-hectare square are given in Figure 9.
2. A 1m cap consisting of silty sediment is considered optimum to isolate the CDM. This will extend over the 9-hectare square (shown schematically in Figure 11) utilising 90,000 cubic metres of clean dredged silty sediment. The sediment will be placed in sweeps (north-south and east-west). The co-ordinates for the 9-hectare square are given in Figure 9.
3. A 0.5m sand cap extending over the 9-hectare square is considered optimum to hold the silt cap and CDM in place and to protect against erosion. Therefore, 45,000 cubic metres of clean sand material will be placed in sweeps (north-south and east-west) over the whole of the 9-hectare square shown schematically in Figures 11 below. The co-ordinates for the 9-hectare square are given in Figure 9.
4. This provides a design for the capping trials as summarised in Figure 12.

It should be noted that an assessment of potential consolidation of CDM, and the cap thickness will be provided following the receipt of geo-technical results from the sampling programs detailed in Sections 4 and 5.

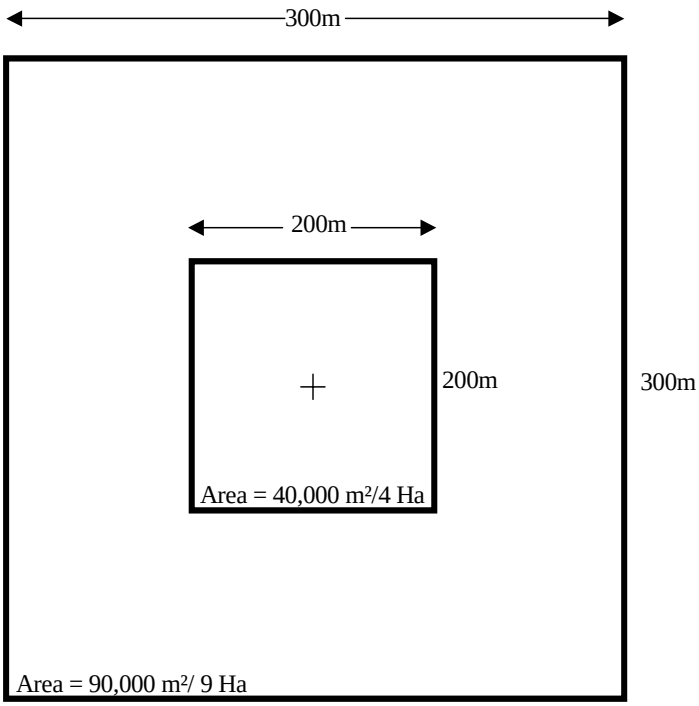


Figure 11. Schematic diagram giving the areas for deposition of CDM and clay cap (inner square) and for sand cap (outer square) (not to scale).

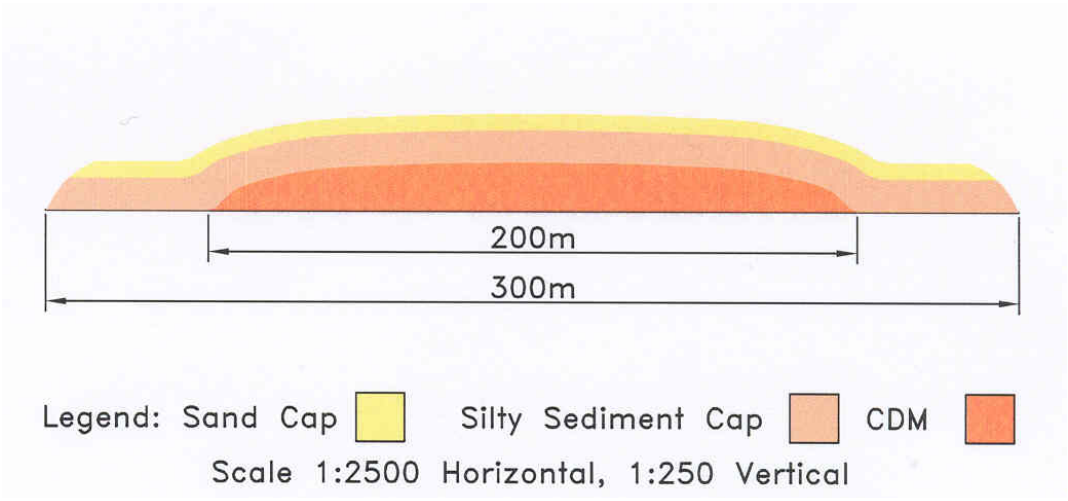


Figure 12. A schematic diagram showing a cross section through CDM and cap.

10. SEDIMENT DISPOSAL & CAPPING

10.1 Purpose

The purpose of this work component is to accurately place "blocks" of CDM within a designated area of the Tyne Souter Disposal Ground ensuring there is minimal contaminant loss to the water column, and then to cover the material with a cap as per design requirements described in Section 9, ensuring there is minimal disturbance of CDM during cap placement.

10.2 Method

10.2.1 Placement Techniques for CDM

Differential GPS (antennae located on the self propelled barge) will be used to accurately locate the central disposal point (as given in Figure 9) for the CDM within the Souter Point (Outer) Disposal Ground. 60,000 cubic metres of CDM and any water entrained in the grab bucket during mechanical dredging will be dropped at this point through a split hopper giving a precision-point discharge.

The USACE (1998) indicate that the retention of sediment in discrete blocks through mechanical dredging ensures minimal stripping of material during descent to the seabed.

If required, modelling of CDM dispersion and loss of contaminants to the water column during CDM placement will be undertaken following the receipt of geo-technical and elutriate testing results from the sampling program detailed in Sections 4 and 5.

It should be noted that as discussed in Section 9, the cap design is based on the worse case scenario of CDM settling to a depth of 1.5m, giving a 4-hectare footprint. However, given the consolidated nature of the material, it is considered that a discrete mound will be gradually built up with a maximum height at the central disposal point of greater than 1.5m.

10.2.2 Placement Techniques for Capping

Capping material can be placed over the mound immediately following placement of the CDM and the findings of a multi-beam survey. It is considered that there will be minimal consolidation of the mechanically dredged material (USACE, 1998). This will be confirmed by an assessment and modelling (if required) of geo-technical data for the CDM.

The hydraulically dredged capping material will be transported by the trailer suction dredger to the disposal area. Once at the disposal ground the capping material will be discharged through a fall pipe. The mouth of the pipe will lie at a depth of 25m. The capping material will be pumped through the fall pipe. Details of this technique are provided in Appendix IX.

This technique will allow control over the discharge rate of capping material and enable the accurate placement of cap material over the required areas. It will also reduce the loss of sediment to the water column and minimise environmental impacts from disturbance of the CDM.

As discussed in Section 9, 90,000 cubic metres of clean, silty dredged-sediment will be placed in sweeps along linear transects (north-south and east-west) over the nine hectare square shown schematically in Figure 11. This will form a cap of approximately 1m.

The use of silty dredged sediment from within the Tyne Estuary for the first cap layer, ensures that there is compatibility in terms of bulk density with the CDM it is covering and this will help to keep disturbance of the CDM to a minimum.

Approximately, 45,000 cubic metres of sand will then be placed in sweeps along linear transects (north-south and east-west) over the 9 hectare square shown schematically in Figure 11. This will give a sand cap of approximately 0.5m. The co-ordinates of the 9-hectare square are provided in Figure 9.

The number of linear transects will be dependant upon the footprint of the CDM mound and the footprint created by the fall pipe. The number of sweeps along the transect will be dependant on the discharge rate and the required thickness of the cap.

It should be noted that the placement of the final sand cap will be at a slower rate than the silt cap below, to reduce the potential for mixing with and disturbance of the lower layer and to ensure stability of the cap as a whole.

10.3 Equipment & Materials

As per Sections 6.3 and 7.3.

10.4 Management Responsibilities

The PTA will be responsible for identifying a suitable contractor for the dredging, transport and disposal operations. The contractor will be responsible for undertaking dredging, transport and disposal operations to the specifications given in their method statement, for developing a contingency plan and back-up for bad weather and equipment failure, and for ensuring that environmental, health and safety requirements are met.

The dredging and disposal contractors will also be responsible for the following:

- Determining the location of the CDM discharge point
- Determining the position and number of linear transects required for cap placement
- Calculating the discharge rate of cap material
- Ensuring the accurate positioning of point discharge and linear transects, that meets the required level of validation set by DEFRA
- Keeping dredge logs recording details of barge position, environmental conditions, vessel headings and velocities, start/end times of discharge and load/draft of barge for auditing purposes and for inclusion into a monitoring database.

CEFAS will be responsible for undertaking dispersion modelling if required, based on USACE techniques and assessment of elutriate testing results following receipt of data from the monitoring programs detailed in Sections 4 and 5. EnviroCentre under contract to PTA, will be responsible for reviewing and undertaking modelling and assessment in parallel with CEFAS, if required.

PTA, EnviroCentre, EA, DEFRA, CEFAS and EN are to be present, as required, during the dredging and disposal operations. The EA will have an overseeing role and PTA will make available a pilot boat.

A Memorandum of Understanding will be produced detailing the responsibilities of key organisations for different work components.

10.5 Environmental Issues

The main environmental issues associated with the placement of the CDM and cap, are the dispersal of sediment and the loss of contaminants to the water column during placement. These issues will be minimised during placement due to the consolidated nature of the CDM and the use of a fall pipe to place the hydraulically dredged (and therefore fluidised) capping material. If required, modelling following receipt of geo-technical and elutriate data will allow the prediction of dispersion of sediment and contaminants to the water column.

Secondly, there is the potential to disturb CDM during the placement of the first cap layer. This will be minimised by controlled placement of the cap using a fall pipe at a depth of 25m, and the use of silty sediment capping material that is compatible with the CDM.

Thirdly, there is the potential for delays to operations due to bad weather and equipment failure, potentially exposing the deposited CDM to the environment for unacceptable periods. This risk will be reduced by developing a contingency plan and ensuring the availability of back-up equipment.

10.6 Health & Safety

The dredging contractor will be required to provide health & safety documentation covering dredging and disposal operations.

10.7 Quality Control

The dredging contractor will be responsible for ensuring that the CDM and capping material are placed according to the specifications provided in this document and the contractor method statement.

10.8 Timeframes

The mobilisation, dredging, placement and demobilising operations for both the CDM and cap material will be approximately 47 days.

11. MONITORING & PERFORMANCE ASSESSEMENT

11.1 Purpose

The purpose of this work component is to undertake monitoring to ensure that capping acts as an effective control measure, CDM is isolated, the long-term integrity of the cap is maintained and risk based management actions are established. Information from the monitoring will assist in the development of best practice extendable to the UK.

It should be noted that a Memorandum of Understanding will be produced, identifying the organisations responsible for each monitoring work component. Details of the monitoring program for the sea-disposal trials will be provided in a separate work-plan currently being developed by CEFAS and EnviroCentre.

11.2 Method

Monitoring will be required before, during and after the placement of CDM and the cap. Table 13 provides an example of the approach used by the USACE (1998) for a capping project monitoring programs. This will be used to assist the development of a monitoring program for the sea-disposal and capping trials.

Table 13. An example of a sample tiered monitoring program for a capping project (USACE, 1998).

Example of a Sample Tiered Monitoring Program for a Capping Project (USACE, 1998)				
Monitoring Program	**Monitoring Frequency**	**Threshold**	**Management (Threshold Not Exceeded)**	**Options (Threshold Exceeded**
Consult site description surveys, technical advisory committee, & EIS for phys/chem baseline conditions.				
TIER I • Bathymetry • Sub-bottom profiles • Side-scan sonar • Surface grab samples • Cores • Water samples	Pre, Post Placement, Annually	• Mound within 5 ft (1.52m) of nav. hazard • Cap thickness decrease 0.5ft (0.15m) • Contaminant exceeds limit in sediment or water sample	• Continue to monitor at same level. • Reduce monitoring level. • Stop monitoring	• Go to next tier • Stop use of site • Increase cap thickness.
TIER II • Bathymetry • Sub-bottom profiles • Side-scan sonar • Sediment profile cam. • Cores • Water samples • Consolidation instru.	Quarterly to Semi-annually	• Cap thickness decreases 1 ft (0.31m). • Contaminant exceeds limit in sediment or water sample.	• Continue to monitor at same level. • Reduce monitoring level.	• Go to next tier. • Replace cap material. • Increase cap thickness. • Stop use of site
TIER III • Bathymetry • Sub-bottom profiles • Side-scan sonar • Sediment profile cam. • Surface grab samples • Cores • Water samples • Tissue samples	Monthly to Semi-annually	• Cap thickness decreases 1 ft (0.31m). • Contaminant exceeds limit in sediment or water sample. • Contaminant exceeds limit in tissue	• Continue to monitor at same level. • Reduce monitoring level.	• Replace cap material. • Increase cap thickness. • Stop use of site • Change cap sediment • Re-dredge and remove

11.2.1 Pre-Trial Monitoring

The objective of pre-trial monitoring is as follows:

- To determine the baseline characteristics of the trial site prior to disposal and capping operations.

Monitoring undertaken historically by CEFAS at the Souter Point (Outer) disposal ground will provide some background data for the trials. This includes the following:

1. A multi-beam survey of the Souter Point (Outer) disposal ground undertaken by CEFAS in 2003, as presented in Figures 8 and 10. This provides some background bathymetric data for the trials. However, an additional and more accurate bathymetric survey of the trial location will be required.

2. CEFAS routine monitoring of the Souter Point (Outer) disposal ground for physical, chemical and biological characteristics. TBT data collected by CEFAS in and around the disposal ground in 2002 and 2003 is provided in Table 12 and Figure 7.

3. CEFAS information on prevailing currents, available by the end of April 2004.

However, other monitoring will be required including measurements of bottom currents and wave height. Details of additional monitoring will be provided in the monitoring program work-plan.

11.2.2 Monitoring During Placement

The objective of monitoring during placement is as follows:

- To define the areal extent and thickness of the CDM deposit to guide cap placement and to monitor any fragmentation of CDM.

Monitoring during placement will include a multi-beam survey undertaken after the placement of the CDM. The findings of the survey will assist in determining the areal extent of the CDM mound and the development of the final plan for cap placement. The survey will need to be accurate to 20 to 30 cms.

However, additional monitoring may be required during placement including short term monitoring of the water column.

Details of monitoring during placement will be presented in the monitoring program work-plan.

11.2.3 Post Trial Monitoring

The objectives of post trial monitoring are as follows:

- To define the extent and thickness of the cap immediately following placement.
- To ensure the integrity and thickness of the cap is maintained.
- To determine the cap effectiveness in isolating the CDM from the environment.
- To provide information for risk based assessment and associated management actions.

- To provide information that can be used in the development of best practice extendable to the UK.

Post trial monitoring will include the following:

1. A second multi-beam survey undertaken immediately following the placement of the two cap layers. This can be compared to the first multi-beam survey (taken after placement of CDM) to determine the achieved thickness and areal extent of the cap. The survey can also be used as a baseline for future multi-beam surveys, which should be repeated annually to ensure that cap thickness is maintained.

2. Sediment grab samples be collected from the CEFAS sampling stations shown in Figure 7 on an annual basis as part of the CEFAS routine monitoring program. Samples should be analysed for TBT, DBT, heavy metals, total PCBs, total PAHs, total petroleum hydrocarbons, percent solids, particle size distribution and biota. Comparisons with background data will allow an assessment of the effectiveness of the trials in isolating the CDM from the benthic environment.

However, additional post-trial monitoring may be required and this will be detailed in the monitoring program work-plan.

11.3 Monitoring Database

The PTA and EnviroCentre will develop a GIS database for all historical and on-going monitoring data associated with the sea-disposal and capping trials. Organisations involved in the trials will co-operate in providing data for the GIS database and for the dissemination of information. The exchange of information will be an essential requirement of the trials.

11.4 Equipment & Materials

The equipment & materials required for each monitoring component will be detailed in the monitoring program work-plan.

11.5 Management Responsibilities

EnviroCentre, under contract to PTA, and CEFAS will be responsible for developing a detailed monitoring program work-plan for the sea-disposal and capping trials. DEFRA and PTA will be responsible for reviewing and agreeing to the monitoring program.

The PTA and EnviroCentre will be responsible for establishing and maintaining a database for all historical and on-going data associated with the trials.

The organisations responsible for managing, funding and assessing the monitoring program will be identified in a Memorandum of Understanding and in the monitoring program work-plan.

The Port of Tyne Authority and the owners of the three priority docks/quays are not responsible for the TBT contamination in the sediments utilised in the trial, therefore it is considered that they will not be responsible for providing funding for monitoring at the Souter Point (Outer) disposal ground.

11.6 Health & Safety

It will be the responsibility of the organisations undertaking monitoring to ensure that a health and safety assessment is undertaken prior to the commencement of any monitoring, that all staff are aware of H&S issues and have the required H&S equipment.

Further details will be provided in the monitoring program work-plan.

11.7 Quality Control

It will be the responsibility of the organisations undertaking monitoring, to ensure that all quality control procedures for sampling, preservation and transport are documented and followed, and that samples are submitted to suitably accredited laboratories.

Further details will be provided in the monitoring program work-plan.

11.8 Timeframes

The timeframe of monitoring will be detailed in the monitoring program work-plan.

12. REFERENCES

EnviroCentre, 2003. *Disposal and Remediation Options for TBT Contaminated Sediments*.

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USACE, 1998. *Guidance for Sub-aqueous Dredged Material Capping*, Technical Report DOER-1.

APPENDIX I

Area of Dredging and Required Sediment Surface for Wallsend Dry Docks and Neptune Yard

APPENDIX II

Bathymetric Survey Showing Existing Sediment Surface for Wallsend Dry Docks and Neptune Yard

APPENDIX III

Depth of Sediment to be Removed from Wallsend Dry Docks and Neptune Yard

APPENDIX IV

Sediment Volume Computation Sheets for Wallsend Dry Docks

APPENDIX V

Sediment Volume Computation Sheets for Neptune Yard

APPENDIX VI

Bathymetric Survey Showing Existing Sediment Surface for Swan Hunters (Slipway Ends)

APPENDIX VII

Depth of Sediment to be Removed from Swan Hunters (Slipway Ends)

APPENDIX VIII

Sediment Volume Computation Sheets for Swan Hunters (Slipway Ends)

APPENDIX IX

Proposed Dredging and Placement Methods for Sea-Disposal Trials